

CLAIMS

What is claimed is:

1. 1. A nozzle for an injection molding machine, comprising:
 - 2 a nozzle body having first and second passageways therethrough;
 - 3 an inner nozzle having a first end and having an orifice at a second end, said inner
 - 4 nozzle having a passageway therethrough in fluid communication with said nozzle body first
 - 5 passageway; and
 - 6 an outer nozzle removably and fixedly coupled to said nozzle body at a first end and
 - 7 having an orifice at a second end, said outer nozzle having a passageway therethrough in fluid
 - 8 communication with said nozzle body second passageway, said inner nozzle being positioned
 - 9 within said outer nozzle passageway.
1. 2. The nozzle of claim 1, wherein said nozzle body further includes:
 - 2 a counter bore defining an inner wall and a ledge, a portion of said inner wall being
 - 3 threaded; and
 - 4 an annular groove in said counter bore ledge, said annular groove being in fluid
 - 5 communication with said nozzle body second passageway.
1. 3. The nozzle of claim 2, wherein said annular groove has a hemispherical shape.
1. 4. The nozzle of claim 2, wherein said outer nozzle further includes:
 - 2 a wall having a threaded portion to matingly engage said nozzle body inner wall
 - 3 threaded portion; and
 - 4 an annular groove on an inner end of said outer nozzle wall positioned to matingly
 - 5 engage said nozzle body annular groove to provide fluid communication between said nozzle
 - 6 body second passageway and an inner surface of said outer nozzle wall.
1. 5. The nozzle of claim 4, wherein said outer nozzle annular groove has a hemispherical
- 2 shape.

- 1 6. The nozzle of claim 4, wherein:
 - 2 said outer nozzle further includes a ledge in said inner surface of said outer nozzle
 - 3 wall; and
 - 4 said inner nozzle further includes a wall having a ledge on an outer surface of said
 - 5 inner nozzle wall, said inner nozzle ledge configured to matingly engage said outer nozzle
 - 6 ledge.
- 1 7. The nozzle of claim 6, wherein said inner and outer nozzles are configured such that
2 when said inner nozzle ledge is matingly engaged with said outer nozzle ledge and said outer
3 wall threaded portion is matingly engaged with said nozzle body inner wall threaded portion,
4 said inner nozzle is retained such that said inner nozzle passageway is in fluid communication
5 with said nozzle body first passageway and said outer nozzle passageway is in fluid
6 communication with said nozzle body second passageway.
- 1 8. The nozzle of claim 7, wherein said nozzle body, said inner nozzle, and said outer
2 nozzle are all substantially concentric.
- 1 9. The nozzle of claim 1, wherein:
 - 2 said inner nozzle orifice and said outer nozzle orifice are substantially concentric and
 - 3 substantially coplanar; and
 - 4 said outer nozzle orifice substantially surrounds said inner nozzle orifice.
- 1 10. The nozzle of claim 9, wherein said inner nozzle orifice has a diameter of
2 approximately 0.020 inch to approximately 0.150 inch.
- 1 11. The nozzle of claim 10, wherein said outer nozzle orifice has a diameter of
2 approximately 0.050 inch to approximately 0.250 inch.
- 1 12. The nozzle of claim 1, wherein a ratio of a diameter of said outer nozzle to a diameter
2 of said inner nozzle is from approximately 1:1 to approximately 10:1.
- 1 13. The nozzle of claim 12, wherein said ratio is less than approximately 5:1.
- 1 14. The nozzle of claim 12, wherein said ratio is less than approximately 3:1.

- 1 15. The nozzle of claim 1, wherein:
 - 2 said inner nozzle orifice and said outer nozzle orifice are substantially concentric and
 - 3 not substantially coplanar; and
 - 4 said outer nozzle orifice substantially surrounds said inner nozzle orifice.
- 1 16. The nozzle of claim 1, wherein:
 - 2 said inner nozzle further includes a wall having an inner surface and an outer surface;
 - 3 said inner surface defines said inner nozzle passageway; and
 - 4 said outer surface has a plurality of radial grooves, said radial grooves being in fluid
 - 5 communication with said nozzle body second passageway.
- 1 17. The nozzle of claim 16, wherein:
 - 2 said radial grooves extend from said inner nozzle first end to an alignment diameter of
 - 3 said inner nozzle;
 - 4 said inner nozzle further includes an annular groove between said alignment diameter
 - 5 and said inner nozzle orifice; and
 - 6 said inner nozzle further includes a plurality of outer passageways providing fluid
 - 7 communication between said radial grooves and said inner nozzle annular groove.
- 1 18. The nozzle of claim 17, wherein:
 - 2 said inner nozzle further includes a tapered section between said inner nozzle annular
 - 3 groove and said inner nozzle second end; and
 - 4 an end of said tapered section and said outer nozzle defines said outer nozzle orifice,
 - 5 said outer nozzle orifice being annular.
- 1 19. The nozzle of claim 18, wherein said inner nozzle further includes a section having a
- 2 substantially uniform diameter between said inner nozzle annular groove and said tapered
- 3 section.

- 1 20. A method, comprising:
 - 2 a) providing a nozzle including:
 - 3 i) a nozzle body having first and second passageways therethrough;
 - 4 ii) an inner nozzle having a first end and having an orifice at a second end, said
inner nozzle having a passageway therethrough in fluid communication with said
nozzle body first passageway; and
 - 5 iii) an outer nozzle removably and fixedly coupled to said nozzle body at a first
end and having an orifice at a second end, said outer nozzle having a passageway
therethrough in fluid communication with said nozzle body second passageway, said
inner nozzle being positioned within said outer nozzle passageway;
 - 6 b) providing a first material to said nozzle body first passageway;
 - 7 c) providing a second material to said nozzle body second passageway;
 - 8 d) discharging said first material from said inner nozzle orifice; and
 - 9 e) discharging said second material from said outer nozzle orifice.
- 10 21. The method of claim 20, wherein steps d) and e) occur simultaneously, at least in part.
- 11 22. The method of claim 20, wherein step d) concludes prior to step e).
- 12 23. The method of claim 20, further comprising f) minimizing waste.
- 13 24. The method of claim 20, wherein step d) includes:
 - 14 flowing said first material through said nozzle body first passageway;
 - 15 flowing said first material through said inner nozzle passageway; and
 - 16 flowing said first material through said inner nozzle orifice.
- 17 25. The method of claim 20, wherein step a) includes providing said nozzle with said
inner nozzle, wherein:
 - 18 said inner nozzle further includes a wall having an inner surface and an outer surface;
 - 19 said inner surface defines said inner nozzle passageway; and
 - 20 said outer surface has a plurality of radial grooves, said radial grooves being in fluid
communication with said nozzle body second passageway.

- 1 26. The method of claim 25, wherein step a) further includes providing said nozzle with
- 2 said inner nozzle, wherein:
 - 3 said radial grooves extend from said inner nozzle first end to an alignment diameter of
 - 4 said inner nozzle;
 - 5 said inner nozzle further includes an annular groove between said alignment diameter
 - 6 and said inner nozzle orifice; and
 - 7 said inner nozzle further includes a plurality of outer passageways providing fluid
 - 8 communication between said radial grooves and said inner nozzle annular groove.